Protect Your Climate

Bay Area Air Quality Management District

Welcome to the Protect Your Climate Curriculum Program!

- Curriculum contains 16 science-based lessons for 4th and 5th grade.
- Lessons investigate the science and causes of climate change and how to take action to protect our climate.
- Hands-on activities explore air quality, energy, waste, and transportation issues related to climate change.
- Science and other State Content Standards addressed.

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PROTECT YOUR CLIMATE CURRICULUM
TEACHER'S GUIDE

Welcome and thank you for choosing to use *Protect Your Climate!* The objective of this curriculum is to teach students about the science, causes, and impacts of climate change. Most importantly, this curriculum seeks to inspire students to protect their climate by empowering them with knowledge, tools, and skills to reduce greenhouse gas emissions in their daily lives.

The Importance of Teaching Climate Protection

Climate change is one of the biggest challenges facing the world. Climate change is caused by the large amounts of greenhouse gases that human activities are releasing into the atmosphere. The largest source of greenhouse gas emissions is the burning of fossil fuels for energy, electricity, and transportation uses. Greenhouse gases trap heat which is leading to global warming and as a result, changes in global climate conditions. Changes in climate worldwide have already and will continue to cause droughts, flooding, wildfires, and food and water shortages. Climate change is a global challenge, however, all of us can act together to avoid severe climate change impacts in the future. This curriculum teaches students how they can take action and reduce greenhouse gas emissions at home, at school, and in the community.

About the Curriculum

This interdisciplinary curriculum uses hands-on demonstrations, interactive activities, discussions, experiments, and home assignments to engage students in understanding and applying important climate change concepts. Students are encouraged to use logic, foresight, and critical thinking in making informed decisions and taking action for climate protection.

We welcome all comments, suggestions, and critiques you may have regarding the *Protect Your Climate* curriculum. Feedback on content, activities, and relevance to California State Content Standards and the Environmental Principles and Concepts is essential in making this educational tool the best it can be.

The *Protect Your Climate* curriculum is a program from the Bay Area Air Quality Management District (District). With the help of Strategic Energy Innovations, the contracted consultant for the program, the District developed *Protect Your Climate* and launched it in schools across the Bay Area.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

Bay Area Air Quality Management District is responsible for maintaining air quality in the San Francisco Bay Area. The *Protect Your Climate* program launches the District's effort to provide climate protection education materials to Bay Area schools.

Strategic Energy Innovations
Helping Communities Enhance Sustainability

Strategic Energy Innovations is a non profit organization that provides energy efficiency and renewable energy consulting and related services to underserved markets including: schools and universities, local governments, small businesses and affordable housing communities.

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How to Use the Curriculum

Target Grade Levels

Protect Your Climate targets 4th and 5th grades but is easily adaptable to other grades. The lessons, background, and support materials are tailored to meet a wide range of student learning styles, skill levels, and prior knowledge.

Topic Sections

The curriculum contains 16 lessons that are presented in four topic sections with three to six lessons in each section and a final lesson that can be used as an assessment for the whole unit. Each section begins with background for teachers on the section topic. The backgrounds summarize definitions, science, and current issues for each topic area.

Climate Change Basics
Students will become aware of the key scientific principles around air pollution and climate change.

Reducing Impacts from Energy Use
Students will discover how energy, and specifically electricity use, is connected to climate change. Students will also examine renewable energy sources and ways to conserve electricity.

Reducing Impacts from Waste
Students will examine their own waste habits at school and learn and discuss the benefits of reducing waste, recycling, and composting.

Reducing Impacts from Transportation
Students will be introduced to how transportation contributes to climate change and will explore ways to avoid emissions from transportation uses.

Tool Kit & Image Library

Protect Your Climate includes a tool kit with necessary materials for the lessons, such as thermometers, hanging scales, and candles. Basic classroom materials, such as paper, pencils, and scissors, are not included in the tool kit. Any additional classroom materials necessary for the lesson are listed in the lesson page sidebar.

The toolkit also includes a CD with images to engage students. Images can be projected with a computer projection system or printed from the CD onto an overhead transparency.

 Look for this camera icon within lessons for image recommendations.

Using the Lessons

The *Protect Your Climate* lessons build knowledge and skills in a sequential manner for students to gain a fundamental understanding of climate change and its causes. Teachers are encouraged to follow the lesson sequence.

Sample Lesson Page

Topic area icon.

Focus and lesson number.

Time needed for lesson.

Lesson title and brief summary of lesson purpose and outcomes.

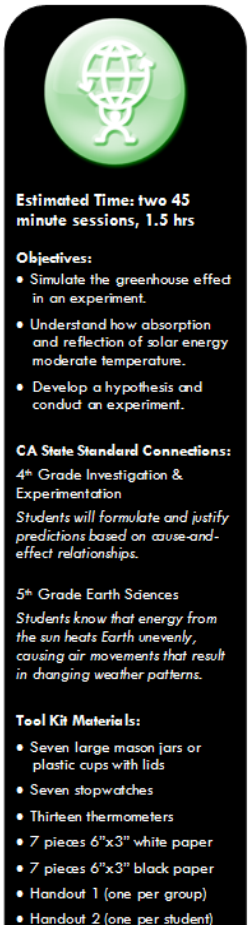
Skills and knowledge to be gained by students.

Important terms introduced in the lesson.

Connections to specific California State Content Standards.

Tips for preparing to teach each lesson.

Materials provided in tool kit and any additional materials.



Climate Change Basics
Lesson 1

Greenhouse Effect

The atmosphere contains both natural and man-made greenhouses gases. These gases allow solar radiation from the sun to pass through the atmosphere and limit the escape of infrared energy that is radiated back by the Earth. This natural function of our atmosphere results in warm temperatures in the lower atmosphere and on the planet's surface. Through discussion and a hands-on experiment, students learn about the scientific principles behind the greenhouse effect and why it is important to life on Earth.

Estimated Time: two 45 minute sessions, 1.5 hrs

Objectives:
- Simulate the greenhouse effect in an experiment.
- Understand how absorption and reflection of solar energy moderate temperature.
- Develop a hypothesis and conduct an experiment.

CA State Standard Connections:

4th Grade Investigation & Experimentation

Students will formulate and justify predictions based on cause-and-effect relationships.

5th Grade Earth Sciences

Students know that energy from the sun heats Earth unevenly, causing air movements that result in changing weather patterns.

Tool Kit Materials:
- Seven large mason jars or plastic cups with lids
- Seven stopwatches
- Thirteen thermometers
- 7 pieces 6"x3" white paper
- 7 pieces 6"x3" black paper
- Handout 1 (one per group)
- Handout 2 (one per student)

Key Words

Atmosphere: layer of gas and microscopic dust that surrounds the Earth.

Greenhouse Effect: the process of the Earth's atmosphere trapping heat.

Solar Radiation: energy emitted from the sun in a variety of forms including visible light, infrared radiation, and ultraviolet radiation.

Preparation

Read the Background on Climate Change Basics for an overview and illustration of the greenhouse effect. Test the experiment before teaching this lesson. It is best to do this experiment on a sunny day; late spring through early fall days would be best. Identify a safe place to leave your jars outside.

Activity 1 Materials: Assemble six sets of materials for groups of 4 students. Each set includes: 1 pint jar or large cup with lids, 1 stopwatch, 1 thermometer, and Handout 1. Thermometers should be at room temperature. You will also need an additional thermometer set in a ball of clay to serve as the control thermometer for the class.

Activity 2 Materials: Add one piece of 6x3 inch black paper, and one 6 x3 inch white paper to each set of Activity 1 materials.

Lesson pages are followed by the lesson procedure which contains guidelines for engaging students, conducting experiments and activities, initiating discussions, and assessing student knowledge.

Assessments

Lessons include suggestions for observing student learning within the course of the lesson activities. These assessment opportunities include journal writing, discussion responses, and completion of activities. Teachers can prepare to use these opportunities by thinking about various levels of performance that can confirm student learning.

 Look for this pencil icon within lessons for student journal prompts.

Inspiring Change Projects

Each section includes a "What Can You Do" page that provides service learning project recommendations to implement at home, at school, or in the community. Service learning integrates classroom learning with meaningful projects outside the classroom. These projects promote civic responsibility by connecting students' lives with issues that affect them, their families, and their communities. Service learning projects also foster opportunities for the community or school to participate in student learning.

Look for inspiring change project recommendations at the end of each lesson, and on the "What Can You Do" page at the end of each section. Inspiring change projects are organized by scope of impact.

 **Small Steps**: projects inspiring personal behavior change.

 **Medium Steps**: projects inspiring change at home and school.

 **Big Steps**: projects inspiring change in the community.

California State Standard Connections

Curriculum lessons provide skill practice for science, reading, writing, research, and mathematical skills. See the Standards Connection table for how lessons connect with State Content Standards.

Environmental Principles & Concepts

Lessons are also aligned with the Environmental Principles & Concepts (EP&C). EP&C are guidelines for integrating environmental studies into grade levels.

Further information about the Education and the Environment Initiative is available at http://www.calepa.ca.gov/Education/EEI/.

Standards, Environmental Principles and Concepts, and Related Subjects Connections per Lesson

	Lesson	California State Content Standards	Environmental Principles & Concepts	Related Subjects
1	The Greenhouse Effect	• 4th Grade Investigation & Experimentation (c) • 4th Grade Measurement & Geometry • 4th Grade Statistics, Data Analysis & Experimentation • 5th Grade Earth Sciences (4) • 5th Grade Mathematical Reasoning	• Principle III: Natural systems proceed through cycles and processes that are required for their functioning. • Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.	Math & Science
2	The Heat is On	• 4th Grade Life Science • 4th Grade Measurement & Geometry • 4th & 5th Grade Statistics, Data Analysis & Experimentation • 5th Grade Earth Science (4) • 5th Grade Mathematical Reasoning • 4th & 5th Grade Reading Comprehension • 4th & 5th Grade Listening & Speaking • 4th Grade History-Social Science (4.1)	• Principle III: Natural systems proceed through cycles and processes that are required for their functioning.	Science, Math, Language Arts & Visual Arts
3	Studying Air Pollution	• 4th Grade Life Science • 5th Grade Investigation and Experimentation • 4th & 5th Grade Visual Arts • 4th & 5th Grade Listening & Speaking	• Principle I: Students understand the health of individuals and human communities depends on the health of natural systems. • Principle IV: Students know that the exchange of matter between natural systems and human societies affects the long-term functioning of both. • Principle V: Students know that decisions affecting natural systems are based on a wide range of considerations and decision-making processes.	Science, Visual Arts & Language Arts
4	Climate Change Action	• 4th Grade Life Sciences • 5th Grade Earth Sciences • 5th Grade Life Sciences • 4th Grade Language Arts Word Analysis & Vocabulary Development • 5th Grade Visual Arts Connections & Applications	• Principle III: Natural systems proceed through cycles that humans depend upon, benefit from and can alter. • Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.	Science, Language Arts, & Visual Arts
5	Energy Choices	• 4th Grade Statistics, Probability & Data Analysis • 5th Grade Earth Sciences • 4th & 5th Grade Physical Education (5.0) Social Interaction • 4th & 5th Grade Listening & Speaking	• Principle II Concept b: Students need to know that methods used to extract, harvest, transport and consume natural resources influence the composition and viability of natural systems. • Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts.	Science, Math, Language Arts, & Physical Education
6	Combustion Energy and Air Pollution	• 4th Grade Investigation & Experimentation (c) • 4th Grade Language Arts Vocabulary Development • 4th & 5th Grade Listening & Speaking	• Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both. • Principle V: Students know that decisions affecting natural systems are based on a wide range of considerations and decision-making processes.	Science & Language Arts
7	Generating Electricity	• 4th Grade Physical Sciences (c) & (d) • 4th Grade Number Sense (3.0) • 4th & 5th Grade Vocabulary Development	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts	Science & Language Arts

8	Using the Sun's Energy	• 4th Grade Physical Sciences • 5th Grade Physical Sciences (b) (c) • 4th & 5th Grade Vocabulary Development • 4th & 5th Grade Physical Education 5.0	• Principle I: Students understand the health of individuals and human communities depends on the health of natural systems.	Science, Language Arts & Physical Education
9	Home Energy Audit	• 4th Grade Physical Sciences (g)	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts.	Science
10	Thinking About Consumption	• 4th Grade Visual Arts Connections & Applications • 4th & 5th Grade Listening & Speaking • 4th & 5th Grade Investigation & Experimentation	• Principle IV Concept b: Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effects.	Visual Arts, Language Arts & Science
11	Class Waste Audit	• 4th Grade Investigation & Experimentation (b) • 5th Grade Investigation & Experimentation (a)	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts.	Science & Math
12	Recycling & The Climate	• 4th Grade Number Sense (1.0) • 4th Grade Statistics Data Analysis (1.0) • 4th Grade Visual Arts (5:3)	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts.	Math, Visual Arts, & Science
13	Composting Benefits	• 4th Grade Life Science (c) • 4th & 5th Grade Listening & Speaking • 4th & 5th Grade Vocabulary Development • 4th & 5th Grade Measurement & Geometry • 4th & 5th Grade Physical Education 5.0	• Principle IV Concept b: Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effects.	Science, Language Arts, Math, & Physical Education
14	Car Tally	• 5th Grade Visual Arts (5:2) • 4th & 5th Grade Statistics, Data Analysis, & Probability • 4th & 5th Grade Mathematical Reasoning • 4th & 5th Grade Investigation & Experimentation	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts. • Principle IV Concept b: Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effects.	Math, Science, & Visual Arts
15	Calculating School Trip Emissions	• 4th Grade Number Sense (3.0) • 5th Grade Mathematical Reasoning • 4th & 5th Grade Listening & Speaking • 4th & 5th Grade Investigation & Experimentation	• Principle IV Concept a: Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of resulting byproducts. • Principle IV Concept b: Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effects.	Science, Language Arts & Math
16	Designing A Clean Air City	• 4th Grade California: A Changing State (4:1) • 4th Grade Visual Literacy (5:3)	• Principle V: Students know that decisions affecting natural systems are based on a wide range of considerations and decision-making processes.	Social Science, & Visual Arts

Toolkit Supplies List

The following toolkit of materials will be needed for conducting the lesson activities.

The following quantities are based on student groups of 4 in a class of 28 students.

The estimated cost for purchasing these materials is approximately $200.

Quantity	Item
7	glass mason jars
7	sheets of white construction paper
7	sheets of black construction paper
7	stopwatches
8	thermometers, long enough to fit in the jar and for the temperature gauge to be seen outside the jar
1	packet of index cards
1	jar of petroleum jelly
1	roll of aluminum foil
1	roll of plastic wrap
7	paraffin candles
7	beeswax candles
1	bar magnet
1	roll of copper wire
2	alligator clips
1	ammeter
1	13 watt compact fluorescent light bulb
1	60 watt incandescent light bulb
1	hanging scale
1	spray bottle
1	plastic bin to store all items

Curriculum Tips

The following teaching tips will help teachers get the most out of the curriculum and address the learning styles of a wide variety of students.

- Read the Background for each lesson to familiarize yourself with the 'big picture.' You may want to print the Background summaries for your students to read.
- Test all demonstrations, experiments, and activities before implementing.
- Include as many students as possible when conducting experiments and demonstrations such as working in a lab format or using students as helpers.
- Build scientific skills from the Investigation and Experimentation standard:
  - Encourage students to make predictions about experiment outcomes and apply the scientific method.
  - Encourage students to create their own tables, charts, and diagrams for the data they gather.
  - In student discussions of controversial issues, encourage students to speak from an informed point of view, citing the source of their knowledge.
  - Lead students to conclusions through the use of questions, rather than telling them the answer.
  - Encourage students to share their knowledge and findings with their school, families, and community.
- Use visuals and models to illustrate concepts and terms. This is especially effective for second-language learners.
- Help students see connections between what they are learning, other curricular areas, and the real world.
- For controversial issues, like how to respond to climate change, provide balanced resources and perspectives from websites, news articles, books, or news clips.
- Encourage students to gather information and knowledge from experts and resources outside the classroom. Use guest speakers and experts as resources when possible.
- Help students understand that as citizens of their community, state, nation, and the world, they have a responsibility for what happens and can make a difference through their choices and actions.
- Learn with your students!

GLOSSARY

Aerobic: decomposition in the presence of oxygen.

Air Pollution: the presence of harmful substances in the air.

Ammeter: device used to measure the electric current in a circuit.

Anaerobic: decomposition in the absence of oxygen.

Atmosphere: layer of gas and microscopic dust that surrounds the Earth.

Carbon Dioxide (CO_2): a gas made of carbon and oxygen atoms that plants use for photosynthesis. CO_2 is a greenhouse gas.

Carbon Footprint: a measure of the total greenhouse gases produced by a process, an activity, or a person. A product's carbon footprint includes all greenhouse gas emissions produced by its lifecycle.

Carpool: to share a ride with other people in one vehicle.

Circuit: path that an electrical current flows through.

Climate: average pattern of weather for an area over a long period of time, 30 years or more.

Climate Change: global shift in long-term climate patterns.

Combustion: chemical process of burning.

Commute: regular travel from two destinations, such as home to work or home to school.

Composting: the process of collecting organic waste and letting it decompose naturally through aerobic decomposition.

Compost: natural decomposition of organic matter, like grass clippings, food scraps, and leaves, that can be used to enrich the soil.

Conservation: careful use and protection of natural resources.

Decomposition: breakdown of organic materials by bacteria and other decomposers, fungus and insects.

Efficiency: amount of work that a machine does compared with the quantity of energy input.

Electric Power Plant: factory that generates electricity.

Electrical Current: flow of electrons.

Electricity: form of energy produced when electrons move from one place to another. We use electricity for light, heat, and power in homes and industries.

Electron: negatively charged particle in an atom.

Energy Audit: evaluation of energy consumption in a home or business to determine ways that energy can be conserved.

GLOSSARY

Energy Input Pathways: concept used to track how energy is consumed through the lifecycle of a product, from its production, consumption, and disposal or reuse.

Fossil Fuels: coal, petroleum, and natural gas are formed over millions of years from the decayed remains of ancient plants and animals.

Fuel: something such as wood or oil which is burned to produce energy.

Fuel Efficient Vehicle: vehicle that requires less fuel to travel compared to other vehicles.

Generator: machine that converts mechanical energy into electrical energy.

Greenhouse Effect: the process of the Earth's atmosphere trapping heat.

Greenhouse Gas: a gas that traps heat in the atmosphere. An over-abundance of greenhouse gases is contributing to climate change.

Idling: an engine running while not doing useful work, such as a car sitting still with its engine running.

Landfill: large outdoor area, usually specially constructed, where waste is dumped and buried.

Manufacturing: process of turning raw materials into products that can be used or consumed.

Methane: a greenhouse gas created by anaerobic decomposition.

Miles per Gallon: number of miles a vehicle can travel on one gallon of fuel.

Mixed Use Community: community with schools, offices, homes, stores, green space, and public spaces easily accessible to one another.

Non-Renewable Energy: energy from a source that cannot be replaced or can only be replaced very slowly by natural processes, usually over millions of years.

Ozone (O_3): ground-level ozone is an air pollutant with harmful effects on the respiratory systems of animals and humans. Ozone in the upper atmosphere filters potentially damaging ultraviolet light from reaching the Earth's surface.

Paraffin: type of wax made from petroleum, a fossil fuel.

Particulate Matter: tiny particles and liquid droplets in the air, including acids, organic chemicals, metals, and dust particles.

Passenger Miles per Gallon: number of miles a single vehicle can travel on one gallon of fuel multiplied by the number of passengers.

Phantom Load: energy used by electrical devices when they are plugged in but not being used.

Photon: tiny particle of radiant energy.

Precipitation: water falling from clouds in any form, such as snow, ice, rain, or drizzle.

Product Lifecycle: the total process of a particular product's manufacture, transportation, use, and disposal.

GLOSSARY

Raw Material: natural material used as input to production.

Reduce: using fewer products and materials in our daily lives.

Recycle: collecting and processing products into new or different products.

Recycled Content: amount of recycled material in a new product.

Renewable Energy: energy from a source that is replaced rapidly by natural processes.

Reuse: to use again.

Solar Cell: device that changes energy from the sun into electricity. A solar panel is comprised of many solar cells.

Solar Radiation: energy emitted from the sun in a variety of forms including visible light, infrared radiation, and ultraviolet radiation.

Soot: fine black particulate matter produced by combustion of coal, oil, wood, or other fuels.

Smog: air pollution made primarily of ozone (O_3) that forms when pollutants from vehicles and industry react in the air with sunlight.

Sustainable: actions done in a manner that do not deplete natural resources faster than they can be naturally replenished.

Traffic: movement of cars and other vehicles on the road.

Transportation: ways of moving people or goods from one place to another.

Turbine: machine that extracts energy from fluid flows like wind, moving water, or steam to do work.

Urban Planner: person who helps plan communities.

Waste: items thrown away and not used again.

Water Cycle: change of water from one state to another as it moves between Earth's surface and atmosphere included the processes of evaporation, condensation, and precipitation.

Weather: short-term condition of the atmosphere at a place for a given time.